REMARKS

The Examiner has objected to the drawings because text in Figures 1 and 2 is not in English. Drawings have been prepared and are being filed with this response.

The Examiner has objected to the Abstract of the Disclosure because it is too long. An amended Abstract is being supplied with this response.

The Examiner has objected to the disclosure, because on page 4 the brief description of the drawing for Figures 1 and 2 does not supply a separate brief description for each figure. Page 4 of the specification has been amended to describe each figure separately. Page 9, lines 3-5 supports the addition of the phrase "at constant cooling rate" added to the description of Figures 1 and 2.

The Examiner has objected to Claim 9 under 37 C.F.R. §1.75(c) as being an improper dependent claim. Claim 9 has been rewritten to include all the limitations of Claim 1. Claim 9 has been further amended to put it in more readable form and to supply a broader amount range for nitrogen. Basis for this amendment may be found on page 6, line 22 of the specification. Claim 9 has further been amended to delete the phrase "in excess of" in the limitation on the cooling rate and to add "≥" in its place. Basis for this amendment may be found on page 8, line 13 of the specification. Claim 10 has been amended to add the limitation on nitrogen to correspond with the change made in Claim 9. Claim 11 has been amended to remove the Markush group and to make it clear that the steel sheet contains COTTRELL atmospheres and/or epsilon carbides. COTTRELL atmospheres and/or epsilon carbides are discussed on page 6, lines 10-11, page 8, line 30 - page 9, line 2 and page 11, lines 8-13 of the specification. New Clam 13 has been added to carry over the limitation on grain count cancelled from amended Claim 11. New Claims 14-18 have been added to preferred embodiments of the invention. Basis for new Claims 14-16 may be found on page 6, line 4 through page 7, line 1 of the specification. Basis for new Claim 17 may be found on

.page 11, lines 26-29 of the specification. New Claim 18 is dependent on Claim 9 and adds the limitation on a plastic deformation operation corresponding to that carried out in Claim 2. No new matter has added into the specification, amended claims or new claims.

REQUEST FOR RECONSIDERATION

Claims 9-18 are active in the case.

Claims 9-12 were rejected under 35 U.S.C. §103 as being unpatentable over the prior art admission in the specification on page 2, lines 12-28, JP06306536, JP07034194, JP07034193, JP07034192 or JP10030152.

It is submitted that the claims distinguish over the combination of references for the following reasons. The prior art discussed on page 2 of the specification does not contain any of the specific steps or conditions recited in the annealing steps in product-by-process Claim 9. For instance, page 2 only recites "continuous annealing at a temperature of between 640 and 700°C" and does not set forth the specific steps in product-by-process Claim 9 of continuous annealing by "raising the temperature of the strip to a temperature higher than the temperature of onset of pearlitic transformation Ac_1, holding the strip above this temperature for a duration longer than 10 seconds, rapidly cooling the strip to a temperature below 100°C at a cooling rate $\geq$ 100°C per second, thermally treating the strip at a low temperature ranging between 100°C and 300°C for a duration in excess of 10 seconds, and cooling the strip to room temperature". Neither does the prior art discussion on page 2 of the specification include the further limitation in the product-by-process Claim 18 "wherein after said rapidly cooling and prior to said thermally treating, a plastic deformation operation is performed comprising an elongation of the strip with a percentage elongation ranging between 1 and 5%".

Further, none of the Japanese Abstracts cited by the Examiner have any teachings which would make the particular annealing process steps of Claims 9 and 18 obvious either through consideration of the references alone or in combination with the prior art discussion on page 2 of the specification. Therefore, it is submitted that Claims 9 and 18 distinguish over what is shown by the combination of references.

With regard to Claims 10-17 it is submitted that, neither the discussion of the prior art on page 2 of the specification nor the Japanese Abstracts cited in combination, show the particular limitation in Claim 10 "when in an aged condition said sheet comprises a percentage elongation A% satisfying the relationship: $(750\text{-Rm})/16.5 \leq A\% \leq (850\text{-Rm})/17.5$ where Rm is the maximum rupture strength of the steel, expressed in MPa". Nor does the combination show the limitation of Claim 11 that the steel sheet contain COTTRELL atmospheres and/or epsilon carbides. Nor does the combination of references show the limitation of Claim 13 that the steel sheet contains a grain count per mm^2 greater than 30,000. Claims 14-16 distinguish over the combination of references, because they further restrict the constituents of the steel sheet and contain the limitations otherwise of Claim 10. Finally, the combination of references does not show the limitation of Claim 17 that the steel sheet contains a grain count per mm^2 greater than 40,000. Therefore, Claims 10-17 also distinguish over the combination of references.

Further, figures in the specification and the discussion thereof show the criticality of steps in the continuous annealing process in order to produce steel having superior characteristics and to meet the equation set forth in Claim 10 and above. For instance, Figures 3 and 4 and the discussion on page 9, line 27 through page 10, line 7 show that the rupture strength Rm of the steel produced when the cooling rate in the annealing process is equal to 100°C/s is 560 MPa, while the rupture strength Rm reaches only 505 MPa if the cooling rate is equal to 50°C/s, outside the range of the process of the present claims. When

the rupture strength Rm of 560 MPa is used in the equation of Claim 10, the inequalities of the equation are satisfied, while when a rupture strength Rm of 505 MPa is used in the equation of Claim 10, the inequalities of the equation are not satisfied.

Figure 5 shows that for the same percentage elongation in the second cold-rolling, the hardness of the steel increases if the cooling rate is equal to 100°C/s over the hardness if the cooling rate is equal to 50°C/s, outside the range of the process of the present claims.

Figure 6 and the discussion thereof on page 10 of the specification shows the importance of the thermal treatment after the rapid cooling step, because when the thermal treatment is carried out at 350°C, the Rm value is equal to 540 MPa, as compared to steels which are treated at temperatures within the range of the process of the present claims, which product Rm values of 560 MPa or more. Further, when 540 MPa is inserted into the equation of Claim 10, the inequalities are not satisfied, while, when Rm of 560 MPa is inserted into the equation of Claim 10, the inequalities are satisfied.

Figure 7 and the discussion on page 10, lines 29-31 further indicates that the thermal treatment of the steel within the range of the present claims makes it possible to increase the percentage elongation A% from 4.8% on the average to 9%, all other things being equal.

Finally, page 11 of the specification and Figure 8 show the importance of the plastic deformation limitation of Claim 18. As discussed on page 11, lines 14-23, at an identical total percentage elongation, the maximum rupture strength Rm of steel A increases significantly if a small plastic deformation by elongation is performed between annealing at high temperature and thermal treatment at low temperature. For instance, the Rm value without a plastic deformation is 660 MPa. However, if an intermediate plastic deformation is performed with a percentage elongation equal to 1%, the total percentage elongation remaining the same, the Rm value is equal to 672 MPa and reaches 700 MPa with an intermediate plastic deformation percentage equal to 3%. Therefore, it is submitted that the

criticality of the process steps in the product-by-process Claims 9 and 18 and the steel produced therefrom meeting the requirements of product Claims 10-17 has been established and, therefore, the claims distinguish over the combination of references.

It is submitted that Claims 9-18 are allowable and such action is respectfully requested.

Respectfully submitted,

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IN THE SPECIFICATION

Please amend the specification as follows:

Page 4, beginning at line 14, delete in its entirety and insert the following paragraph:

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig[s]. 1 [and 2 are] is a diagram[s] showing the influence of annealing temperature at constant cooling rate on maximum rupture strength Rm;

Fig. 2 is a diagram showing the influence of annealing temperature at constant cooling rate on maximum rupture strength Rm;

Fig. 3 is a diagram showing the influence of cooling rate on maximum rupture strength Rm;

Fig. 4 is a diagram showing the influence of cooling rate on maximum rupture strength Rm and on the percentage elongation A%;

Fig. 5 is a diagram showing the influence of cooling rate on hardness HR30T;

Fig. 6 is a diagram showing the influence of the thermal treatment at low temperature on maximum rupture strength Rm;

Fig. 7 is a diagram showing the influence of the thermal treatment at low temperature on the percentage elongation A%;

Fig. 8 is a diagram showing the influence of the plastic deformation by elongation on maximum rupture strength Rm.

IN THE CLAIMS

Please amend the claims as follows:

9. (Amended) A steel strip, produced by a process comprising:.

hot-rolling a steel strip comprising between 0.050 and 0.080% by weight of carbon, between 0.25 and 0.40% by weight of manganese, less than 0.020% by weight of aluminum, and between [0.010] <u>0.008</u> and [0.014] <u>0.016</u>% by weight of nitrogen, the remainder being iron and inevitable trace impurities, to form a strip;

subjecting said strip to a first cold-rolling;

annealing said cold-rolled strip;

optionally, subjecting said annealed strip to a second cold-rolling;

wherein said annealing is a continuous annealing comprising:

raising the temperature of the strip to a temperature higher than the temperature of onset of pearlitic transformation Ac_1,

holding the strip above this temperature for a duration of longer than 10 seconds,

rapidly cooling the strip to a temperature below 100°C at a cooling rate [in excess of] $\geqq$ 100°C per second,

thermally treating the strip at a low temperature ranging between 100°C and 300°C for a duration in excess of 10 seconds, and

cooling the strip to room temperature.

10. (Amended) A steel sheet with low aluminum content, comprising:

between 0.050 and 0.080% by weight of carbon,

between 0.25 and 0.40% by weight of manganese,

less than 0.020% by weight of aluminum, and

between [0.010] <u>0.008</u> and [0.014] <u>0.016</u>% by weight of nitrogen, the remainder being iron and inevitable trace impurities, wherein

when in an aged condition said sheet comprises a percentage elongation A% satisfying the relationship:

$$(750 - Rm)/16.5 \leq A\% \leq (850 - Rm)/17.5$$

where Rm is the maximum rupture strength of the steel, expressed in MPa.

11. (Amended) The steel sheet according to claim 10, <u>wherein said steel sheet comprises</u> further [comprises]:

[at least one selected from the group consisting of]COTTRELL atmospheres and<u>/or</u> epsilon carbides [precipitated at low temperature; and

a grain count per mm^2 greater than 30000].

Claims 13-18 (New).

<u>IN THE ABSTRACT OF THE DISCLOSURE</u>

Page 16, beginning at line 2 and ending at line 31, delete the paragraph and insert the following paragraph:

The present invention provides a process for manufacturing a steel strip with low aluminum content, which includes:

hot-rolling a steel strip including between 0.050 and 0.080% by weight of carbon, between 0.25 and 0.40% by weight of manganese, less than 0.020% by weight of aluminum, and between 0.010 and 0.014% by weight of nitrogen, the remainder being iron and inevitable trace impurities, to form a strip;

subjecting the strip to a first cold-rolling, to produce a cold-rolled strip;

annealing the cold-rolled strip, to form an annealed cold-rolled strip;

optionally, subjecting the annealed cold-rolled strip to a secondary cold-rolling;

wherein the annealing is a continuous annealing comprising:

raising the temperature of the strip to a temperature higher than the temperature of onset of pearlitic transformation Ac_1,

holding the strip above this temperature for a duration of longer than 10 seconds,

rapidly cooling the strip to a temperature below 100°C at a cooling rate in excess of 100°C per second,

thermally treating the strip at a low temperature ranging between 100°C and 300°C for a duration in excess of 10 seconds, and

cooling the strip to room temperature and steel sheet produced therefrom. [The present invention also provides a steel sheet with low aluminum content, which includes:

between 0.050 and 0.080% by weight of carbon,

between 0.25 and 0.40% by weight of manganese,

less than 0.020% by weight of aluminum, and

between 0.010 and 0.014% by weight of nitrogen, the remainder being iron and inevitable trace impurities, wherein

when in an aged condition said sheet includes a percentage elongation A% satisfying the relationship:

$$(750 - Rm)/16.5 \leq A\% \leq (850 - Rm)/17.5$$

where Rm is the maximum rupture strength of the steel, expressed in MPa.]